Validation of the bodily expressive action stimulus test among Chinese adults and children*

Yunmei Yang, Wenwen Hou & Jing Li*

1.CAS Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, Beijing 100101, China

2.Department of Psychology, University of Chinese Academy of Sciences, Beijing 100049, China

Abstract

Objective: The bodily expressive action stimulus test (BEAST) is developed to provide a set of standardized emotional stimuli for experimental investigations of emotion and attention, and the consistency has been validated in adult populations abroad. However, the consistency of this test in Chinese population is unclear. To this end, 42 images of each category of emotion (happiness, sadness, fear and anger) were selected from 254 images of the original stimulus set to further examine the consistency of the BEAST in Chinese population.

Methods: Thirty-one Chinese college students and 41 Chinese preschool children participated in this study. All of them were asked to complete an emotion recognition and judgment task.

Results: Results showed that adults had a high degree of consistency in rating these pictures, while the children's consistency was at a medium level. For adults, sadness was the easiest to recognize, followed by fear, anger and happiness were the hardest to recognize. For children, fear was the easiest to recognize, anger and sadness were second, and happiness was also the hardest to recognize. At the same time, adults were more accurate in identifying happiness and sadness than children. For adults, they were more likely to confuse positive emotions with negative emotions. They tended to mistake sadness, fear and anger for happiness. For children, they were more likely to identify sadness as fear and happiness. And they also tended to recognize anger as fear.

Limitations: Fear and anger emotional pictures are suitable in children aged about 5 whereas the applicability of sadness and happiness, especially happy emotional pictures are not ideal.In the picture materials can be improved, and the body posture pictures conveying happiness and sadness can be re-shot in combination with the actual life situation of Chinese people. Meanwhile, children in the lower years of primary school can be selected for exploration.

---

* This research is funded by National Science Foundation of China (Grant No. 31971009); Youth Innovation Promotion Association Chinese Academy of Sciences; the Special Program for Basic Resources Survey of the Ministry of Science and Technology of China (Grant No. 2017FY101106).

* Corresponding author: Jing Li (E-mail: lij@psych.ac.cn).

Conclusions: These results indicate that the recognition performance of BEAST images for Chinese and Western adults are roughly the same, however, under the same cultural context, the recognition performance of adults and children are very different, and generally the recognition accuracy rate of adults is higher than that of children.

Keywords: Body expression; Adults; Children; Emotion; China

1. Introduction

The development of human beings is a process of constantly understanding, transforming and adapting the world. Emotions, as one of the important adaptive ways, can not only help infants who do not have independent survival and language ability to convey information, but also reflect the psychological activities of adults. People can transmit their attitudes and thoughts through emotional expression including facial expressions, intonation expressions and body expressions (Sauter, McDonald, Gangi, & Messinger, 2014; Van den Stock, Righart, & de Gelder, 2007).

Facial expressions are commonly used to convey emotional information, and commonly used in emotion research. However, in our daily life and social interactions, facial expressions often work together with sensory stimuli such as sight, hearing, smell, taste, and somatosensory, among which body expressions are one of the main visual stimuli related to facial expressions (Frijda, 1986, 1988). Individuals can not only recognize facial expressions, but also emotional information conveyed by body posture. This is mainly due to the similarities between the mechanisms of processing and recognizing body expressions and facial expressions (Hadjikhani & de Gelder, 2003; van de Riet, Grezes, & de Gelder, 2009; Ding, Kang, Zhao, & Fu, 2018; Zhang, Zhao, Liu, & Chen, 2015). Meanwhile, these two expressions do not exist in isolation, but influences each other to a large extent (Civile & Obhi, 2016). The recognition of body expression will affect that of the facial expression, especially when the two are inconsistent (Mondloch, Nelson, & Horner, 2013; Van den Stock & de Gelder, 2014; Van den Stock, Righart, & de Gelder, 2007).

A recent study explored whether body posture or face that promoted emotion recognition in social interactions. It was found that when the body posture (with or without a face) conveys emotional information, it promoted the emotional recognition of individuals, while the faces alone did not (Abramson, Petranker, Marom, & Aviezer, 2020). Therefore, it is more effective to study emotions through body posture, especially for the specific groups (prosopagnosia, autism). It was found that patients with prosopagnosia are not only impaired in face perception ability, but also have certain deficits in body posture perception (Biotti, Gray, & Cook, 2017; Righart & de Gelder, 2007). However, this deficit is not as prevalent as the core feature of face perception deficit, and the body perception ability of acquired facial agnosia patients is intact (Susilo, Yovel, Barton, & Duchaine, 2013). Further, studies found that patients with autism also have atypical facial gaze patterns (Nyström, Bölte, & Falck-Ytter, 2017; Yamashiro et al., 2018). High-risk children pay less attention to faces than low-risk children (Nyström et al., 2017), and children who are later diagnosed with autism showed reduced attention on the face area as early as six months after birth (Shic, Macari, & Chawarska, 2014). Meanwhile, increased fixation of areas other than the face (for example, increased attention to body parts) (Jones & Klin, 2013).Therefore, in the visual emotion research of facial

agnosia and autism patients, it would be more effective to use body expression materials than face expression materials.

In short, the study of body expressions can not only expand the visual stimulation of emotional research, but also can be used to study special groups. Different from facial expression materials that have become mature and standardized (Langner et al., 2010; Limbrecht-Ecklundt, Hoffmann, Scheck, Walter, & Traue, 2013; Young, Perrett, Calder, Sprengelmeyer, & Ekman, 2002), body expression research started relatively late, and the unification and standardization of stimulus materials are not perfect. At present, the stimulation set that has been developed consists of the body expressions presented by the point light displays (Atkinson, Dittrich, Gemmell, & Young, 2004) and the real body expressions (Aviezer, Trope, & Todorov, 2012; Bänziger, Mortillaro, & Scherer, 2012; de Gelder & Van den Stock, 2011; Thoma, Soria Bauser, & Suchan, 2013). Although the point light displays stimulation of the body posture can also convey rich emotional information, the ecological validity may not be as good as the real body posture. However, the real body expression stimulation sometimes appears with the face, so it may cause distraction (Civile & Obhi, 2016). Based on this, the bodily expressive action stimulus test (BEAST) developed and evaluated by de Gelder et al. in 2011 blurs the faces to avoid its influence on body expressions. The database was composed of 254 whole body expressions from 46 non-professional actors to make expressing happiness, sadness, fear, and anger based on real-life situations. These body postures not only express the inner emotional feelings, but also emphasize the action dimension of the entire body postures, thus it is suitable for emotional research (de Gelder & Van den Stock, 2011; Watson & de Gelder, 2020). The original study selected 19 Western adults to conduct a standardized assessment of the stimulus set, and found that Western adults had a high consistency of assessment, and the accuracy of identifying negative emotions was higher than that of positive emotions (de Gelder & Van den Stock, 2011). Some studies have confirmed the availability of this database (Bannerman, Milders, & Sahraie, 2010; Hajduk, Klein, Bass, Springfield, & Pinkham, 2019; Ross & Flack, 2019; Watson & de Gelder, 2020).

Although the usability of this database has been confirmed, its applicability in the context of Eastern culture has not been well verified. Though the emotional experience is our internal experience, the behavior of expressing emotions is affected by many aspects. Among them, culture not only affects the expression of emotions (Jack, Garrod, Yu, Caldara, & Schyns, 2012), but also affects the judgment of the external intensity of emotions and internal subjective experience (Engelmann & Pogosyan, 2013). Cross-cultural research on facial expressions revealed that there are cultural differences in facial expressions, especially in negative emotions, and Western people are better at emotion recognition (Elfenbein & Ambady, 2003). From the perspective of the correlation between facial expressions and body expressions, the standardized assessment of body expressions in Chinese population is helpful to expand the scope of application of the body postural expression stimulus set, and facilitate the use of the stimulus set as a stimulus material for the study of body expressions in

Chinese population. Therefore, this study selected Chinese adults to evaluate some BEAST images, in an attempt to explore the applicability of the database among Chinese adults.

Adults and children have different ability to recognize emotions (de Sonneville et al., 2002; Morton & Trehub, 2001; Nelson & Mondloch, 2018; Segal, Reyes, Gobin, & Moulson, 2019). There are two different views on the ability of adults and children to recognize body expressions. One view is that adults and even children can recognize body expressions well (Atkinson, Dittrich, Gemmell, & Young, 2004; de Gelder & Van den Stock, 2011). Another view is that children are different from adults when it comes to recognizing the body postures of blurred faces (Nelson & Mondloch, 2018), and that even adolescents are still less accurate than adults when it comes to recognizing basic emotions (Heck, Chroust, White, Jubran, & Bhatt, 2018). Therefore, this study mainly selected 5-year-old preschoolers to evaluate the BEAST, and made comparison with adults to explore the differences between adults and children. There are two main reasons why we choose preschoolers. First, early childhood is a critical period for the development of emotion recognition ability (Parkman & Gottman, 1989; Malatesta-Magai & Haviland, 1992). Second, by the age of 5, most children are able to accurately recognize the facial expressions that express basic emotions (Heck et al., 2018; Widen & Russell, 2008). In addition, children at this age can understand and use symbolic gestures and it seems that they can also express emotions through body gestures, and understand the emotional significance of body postures (Boyatzis & Satyaprasad, 1994).

In summary, this study has two main purposes: 1) To evaluate the localized materials of BEAST, and to explore the applicability of the stimulus set in Chinese adults and children. 2) To explore the differences between adults and children in recognition of body expression.

2. Methodology (Design/Approach)

2.1 Participants

The adult participants selected 31 students from a certain university in Beijing (16 males, 15 females, mean age = 22.77 years, SD = 1.78 years). Forty-one children from a kindergarten in Beijing (20 boys, 21 girls, mean age = 5.65 years, SD = 0.58 years). All participants have normal color vision and normal or corrected-to-normal visual acuity. Before the experiment, the participants were informed of the experiment content, the adult participants signed the informed consent by themselves, and the children participants obtained the consent of their parents. The experiment procedures and protocols were approved by the Institutional Review Board of the Institute of Psychology, Chinese Academy of Sciences.

2.2 Procedure

The picture materials used in the experiment were downloaded from the website www.beatricedegelder.com/beast.html, and the average recognition accuracy rate of all pictures by Western subjects was 92.5%, the overall scores were highly consistent (de Gelder & Van den Stock, 2011). In order to achieve maximum applicability, 42 pictures of each emotion (happiness, sadness, fear and anger) were selected from 254 pictures, and the overall recognition accuracy of these pictures was higher than 90% (for example, see Fig 1). Eight pictures (2 for each emotion) were randomly selected for the practice stage, and practiced twice for each picture. The remaining 160 pictures were used in the formal experiment.

The experiment program was presented by E-Prime software, and the pictures were presented randomly during the experiment. Participants practiced with 8 pictures after the instruction. Each trial began with a fixation for 500ms to inform the participants of the upcoming task. Next, a picture was presented, and the participants pressed keyboard after the recognition of emotions expressed by body posture. The "A", "D", "J" , and "L" keys represents happiness, sadness, fear and anger, respectively. The key-press time was not limited. After participant completed one trial, it would enter the next trial, and after the exercise, it would enter the formal experiment. Each participant completed 176 trials, including 16 practice trials. A certain fee was paid after the experiment.

The instructions were changed to make it easier for children to understand, and the buttons were replaced with more child-friendly emoticons. Before the experiment, the experimenter explained the contents and the rule of the experiment to the children, and used the buttons to test whether the children understood the rules. Children who did not understand the experimental content and the rules of the buttons after three explanations were regarded as giving up, and finally two children gave up the experiment. After confirming that the children understand the experimental process, the experiment began. The experimental process is same as the adult experiment. After the experiment, small gifts were given to the children as rewards.

2.3 Data analysis

Statistical software SPSS 24.0 was used for the data analysis. The overall rater agreement was calculated using Fleiss' Generalized kappa. The recognition accuracy and the proportion of incorrect recognitions of emotion (e.g., when the target emotion was happiness, the proportion of happiness was misidentified as sadness, fear or anger) were compared between adults and children by conducting ANOVA.

3. Results

3.1 Comparison of emotion recognition accuracy between adults and children

The emotion recognition data of adults and children were drawn as hotspot graphs (Fig 2 and Fig 3, respectively). The larger the color patch area, the more the target emotion is recognized as its corresponding emotion.

The average recognition accuracy of adults for all images was 85.30%, among which the recognition accuracy of sadness was the highest, and anger was the lowest (see Fig 2). The overall rater agreement was calculated using Fleiss' Generalized kappa and measured value was 0.66, which means that the overall scores of adults were highly consistent. The average recognition accuracy of children for all images was 74.66%, among which the fear was the most accurate one, then was anger and sadness, and happiness was the least accurate (see Fig 3). The Fleiss' Generalized kappa was 0.47, and the overall score were moderately consistent.

Recognition accuracy of emotion recognition was analyzed by conducting a 2 (group: adults and children) × 4 (emotion: happiness, sadness, fear and anger) repeated measures analysis of variance (ANOVA). It was found that the main effect of group was significant, $F(1, 280) = 16.28$, $p < .001$, $\eta^2 = .06$. There was a significant main effect of emotion, $F(3, 280) = 11.33$, $p < .001$, $\eta^2 = .11$. The interaction between group × emotion was also significant, $F(3, 280) = 5.09$, $p < .01$, $\eta^2 = .05$. Further analysis showed that adults' recognition accuracy of sadness ($p < .01$) and fear ($p < .05$) were significantly higher than happiness and anger (see Fig 4). The accuracy of children's recognition of sadness ($p < .05$), fear ($p < .001$), and anger ($p < .01$) was higher than happiness; the recognition accuracy of fear was higher than sadness ($p < .01$) and anger ($p < .05$) (see Fig 5). Adults had significantly higher recognition accuracy of happiness ($p < .001$) and sadness ($p < .001$) than children, while the two groups had no significant difference in the recognition accuracy of fear and anger (see Fig 6).

3.2 Comparison the proportion of incorrect recognitions of emotion between adults and children

We considered the group and target emotion misidentification (e.g., when the target emotion was happiness, it may be misidentified as sadness, fear and anger) as independent variables, and the proportion of incorrect recognitions of emotion as the dependent variable to perform a 2×3 (ANOVA).

The misclassification analysis of happiness found that the main effect of group was significant, $F(1, 210) = 14.88$, $p < .001$, $\eta^2 = .067$. The main effect of the target emotion misidentification was not significant, $F(2, 210) = .49$, $p = .62$, $\eta^2 = .01$. The interaction between group and target emotion misidentification was significant, $F(2, 210) = 5.34$, $p < .01$, $\eta^2 = .05$. Further analysis showed that adults were more likely to identify happiness as sadness ($p < .05$) and anger ($p < .05$). There was no significant difference in the proportion of incorrect recognitions of happiness among children. But children were more likely than adults to identify happiness as fear ($p < .001$).

The misclassification analysis of sadness found that the main effect of group was significant, $F(1, 210) = 22.62$, $p < .001$, $\eta^2 = 1.00$. The main effect of the target emotion misidentification was significant, $F(2, 210) = 13.78$, $p < .001$, $\eta^2 = .12$. The interaction between group and target emotion misidentification was significant, $F(2, 210) = 4.14$, $p < .05$, $\eta^2 = .04$. Further analysis showed that children tended to identify sadness as happiness ($p < .001$) and fear ($p < .001$), adults easily identified sadness as happiness ($p < .05$). Compared with adults, children were more likely to recognize sadness as happiness ($p < .05$) and fear ($p < .001$).

The misclassification analysis of fear found that the main effect of group was not significant, $F(1, 210) = .57$, $p = .45$, $\eta^2 = .003$. The main effect of the target emotion misidentification was also not significant, $F(2, 210) = 1.61$, $p = .20$, $\eta^2 = .02$. There was a significant interaction between group and target emotion misidentification, $F(2, 210) = 3.44$, $p < .05$, $\eta^2 = .03$. Further analysis showed that adults tended to identify fear as happiness ($p < .05$). There was no significance in the proportion of incorrect recognitions of fear among children, but compared with adults, children were more likely to identify fear as anger ($p < .05$).

The misclassification analysis of anger found that the main effect of group was not significant, $F(1, 210) = .07$, $p = .80$, $\eta^2 < .001$. The main effect of the target emotion misidentification was significant, $F(2, 210) = 7.7$, $p < .01$, $\eta^2 = .07$. The interaction between group and target emotion misidentification was marginal significant, $F(2, 210) = 2.55$, $p = .08$, $\eta^2 = .02$. Further analysis showed that both adults and children were more likely to identify anger as fear ($p < .05$), and adults tended to identify anger as happiness ($p < .001$).

4. Discussion

The results of this study showed that Chinese adults had a high consistency in the evaluation of BEAST picture materials. Sadness was easiest to identify, followed by fear, anger and happiness were more difficult to identify for Chinese adults. This recognition pattern is roughly the same as that of the Western adults (de Gelder & Van den Stock, 2011), and both Chinese adults and Western adults were good at recognizing negative emotions, especially sadness and fear. There is evidence that compared with positive events, negative events have a greater impact on people, and individuals pay more attention to negative emotions, which could explain the better recognition of negative emotions (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Gross, Crane, & Fredrickson, 2010). However, there were significant differences between Chinese and Western adults. The overall accuracy of Chinese adults and the accuracy of sadness, fear and anger were significantly lower than those of Western adults. Although the recognition accuracy of happiness is lower than that of Western adults, the difference is not significant. Previous studies have found that when members expressing and recognizing emotion come from the same cultural background, cultural familiarity seems to improve

the accuracy of emotion recognition, which is the in-group advantage of cross-cultural emotion recognition (Elfenbein & Ambady, 2002). The greater the cultural difference between emotion expresser and recognition, the greater the difference in emotion recognition accuracy. The emotional images used in this study were all taken and evaluated by Western adults. Cultural familiarity makes the recognition accuracy of Western adults higher. There are also great differences between Chinese and Western cultures. Western individuals respect individualism more, while collectivism in traditional Chinese culture has a deep influence on Chinese. Therefore, according to the cultural differences mentioned above, Chinese adults perform worse than Western adults in recognizing emotional pictures expressed and taken by Western adults.

Comparing the identification errors of Chinese and Western adults, it is found that Chinese adults tend to confuse negative emotions with positive emotions, while Western adults do not have significant emotional confusion. On the one hand, this may be due to the fact that the body posture of Westerners expressing emotions is more free, open and direct than that of Chinese people, while Chinese people are more restrained (Markus & Kitayama, 1991). Therefore, the Chinese people are relatively low when identifying pictures taken by Western people, and cultural sensitivity makes Western individuals' accuracy higher (Elfenbein & Ambady,2003a). On the other hand, it may be due to the selected pictures have high recognition accuracy among Western adults.

In contrast, the children had only moderate agreement with all the images. For children, fear was the easiest to recognize, anger and sadness were the second, and happiness was the hardest to recognize. It was obvious that the emotion recognition mode of children was significantly different from that of the adults. They could hardly recognize happy body expressions, but they performed better in the recognition of fear and anger. This is inconsistent with prior studies that happiness and sadness are more easily recognized by children and sadness is the first emotion that children recognize (Izard, 1971; Oleszkiewicz, Frackowiak, Sorokowska, & Sorokowski, 2017). The view of embodied emotion has found that the brain regions that express and recognize emotions activation are similar (Jackson, Meltzoff, & Decety, 2005; Mclntosh, Reichman-Decker, Winkielamn, & Wilbarger, 2006). Through verbal questioning, it was known that children would imitate the body posture in the picture to recognize the body expression in the picture. At the same time, results from oral questioning found that children usually put the body posture expressing sadness in the happy situation, which may be the reason for the lower recognition accuracy of sadness. On the other hand, body expressions reveal the close relationship between emotions and adaptive behaviors. Body postures that express fear and anger are related to the threats in the environment. Even if the facial information is blurred or removed, we can still recognize body postures conveying threat information very well (Bannerman, Milders, de Gelder, & Sahraie, 2009). From an evolutionary point of view, being able to quickly identify body postures that convey fear or anger can help human beings respond in time (flee or fight) (Bannerman

et al., 2009). Better recognition of fear and anger in children may be beneficial to the adaptation of the surrounding threatening environment and reaction in time.

This study found that adults were significantly better than children in recognizing happy and sad, but their performance in recognizing fear and anger was similar. Compared with faces that express anger and fear, children paid more attention to body posture, and this attention reached an adult level, which enabled them to perform similarly in recognizing the two emotions (Nelson & Mondloch, 2017). Good ability to recognize negative emotion is important for the survival and development of a race, because recognizing emotions with threat signals faster and more accurate will help individuals to prepare for timely response (Bannerman et al., 2009). Therefore, the identification of negative emotions (such as anger) is more meaningful than identifying positive emotions (such as happiness) for the adaptive survival of individuals (Aronoff, Woike, & Hyman, 1992; Hansen & Hansen, 1988), especially for children with weak viability, accurately identifying negative emotions, such as fear and anger, seems to help them reduce the possibility of encountering potential dangers.

Analysis of the proportion of incorrect recognitions of emotion indicated that adults were more likely to confuse positive emotions with negative emotions, which confirmed the findings of previous studies (Atkinson et al., 2004; Dittrich, Troscianko, Lea, & Morgan, 1996; Gross et al., 2010). The confusion of these two emotions can be explained by the similarity of body posture, such as expressing emotions accompanied by clenched fists and raised arms (Dittrich et al., 1996; Ross & Flack, 2019). These features were found in the pictures we selected. Children not only tended to confuse negative emotions, but also are more likely to confuse positive emotions with negative emotions than adults. Children tended to mistake sadness and anger for fear, perhaps because children around 5 years old cannot use reliable cues to distinguish sadness and fear as adults do (Boone & Cunningham, 2001). The confusion about happiness, anger and fear can be traced to the confusion of anger and happiness, which may be due to the similarity of selected body postures and expressions, such as the tendency of arms to lean forward (Ross & Flack, 2019).

In summary, the BEAST images validated in this study are more suitable for Chinese adults. Although culture leads to differences in recognition accuracy in Chinese and Western adults, but the overall recognition pattern is similar. Fear and anger emotional pictures are suitable in children aged about 5 whereas the applicability of sadness and happiness, especially happy emotional pictures are not ideal. In the future, the picture materials can be improved, and the body posture pictures conveying happiness and sadness can be re-shot in combination with the actual life situation of Chinese people. Meanwhile, children in the lower years of primary school can be selected for exploration. Chinese adults and children have very different recognition patterns for the four emotions, and adult performance is better than children. In the future research, based on the assessment results, we can use the selected picture materials to train children to explore whether the accuracy of emotional identification can be improved.

5. Conclusion

To sum up, the BEAST images selected in this study are more suitable for Chinese adults. Sadness is the easiest to identify, followed by fear, happiness and anger are the hardest to identify. The applicability in children is moderate, fear is the easiest to identify, followed by anger and sadness, and happiness is the most difficult to identify. Chinese adults and children have different recognition patterns for the four emotions, and adults have higher recognition accuracy than children.

Author Contribution Statement

Jing Li : designed the research, Wenwen Hou prepared the experiment procedure, Yunmei Yang collected the data and wrote the first draft of the manuscript.

Jing Li : She proposed the research question and modified the manuscript.

Wenwen Hou : She prepared the experiment procedure and modified the manuscript.

Yunmei Yang : She collected and analyzed the experimental data, and wrote the manuscript.

References

Abramson, L., Petranker, R., Marom, I., & Aviezer, H. Social interaction context shapes emotion recognition through b ody language, not facial expressions. Emotion, 2020. Retrieved on March 18, 2021, from https://pubmed.ncbi.nlm. nih.gov/31971411/. DOI:10.1037/emo0000718.

Aronoff, J., Woike, B. A., & Hyman, M. Which are the stimuli in facial displays of anger and happiness? Configuration al bases of emotion recognition. Journal of Personality and Social Psychology , 1992, 62(6): 1050-1066. Retrieved on March 18, 2021, from https://sci-hub.se/10.1037/0022-3514.62.6.1050. DOI:10.1037/0022-3514.62.6.1050.

Atkinson, A. P., Dittrich, W. H., Gemmell, A. J., & Young, A. W. Emotion perception from dynamic and static body expressions in point-light and full-light displays. Perception, 2004, 33(6): 717-746. Retrieved on March 18, 2021, from https://sci-hub.se/10.1068/p5096. DOI:10.1068/p5096.

Aviezer, H., Trope, Y., & Todorov, A. Body cues, not facial expressions, discriminate between intense positive and nega tive emotions. Science, 2012, 338(6111): 1225-1229. Retrieved on March 18, 2021, from https://pubmed.ncbi.nlm. nih.gov/23197536/. DOI:10.1126/science.1224313.

Bannerman, R. L., Milders, M., de Gelder, B., & Sahraie, A. Orienting to threat: Faster localization of fearful facial exp ressions and body postures revealed by saccadic eye movements. Proceedings of the Royal Society B: Biological Sciences, 2009, 276(1662): 1635-1641. Retrieved on March 18, 2021, from https://www.researchgate.net/publicati on/23994343. DOI:10.1098/rspb.2008.1744.

Bannerman, R. L., Milders, M., & Sahraie, A. Attentional cueing: Fearful body postures capture attention with saccades. Journal of Vision,2010, 10(5): 23. Retrieved on March 18, 2021, from https://sci-hub.se/10.1167/10.5.23. DOI:https://doi.org/10.1167/10.5.23.

Bänziger, T., Mortillaro, M., & Scherer, K. Introducing the geneva multimodal expression corpus for experimental research on emotion perception. Emotion, 2012, 12(5): 1161-1179. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/51796867. DOI:10.1037/a0025827.

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. Bad is stronger than good. Review of General Psychol ogy, 2001, 5(4): 323-370. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/46608952. DOI:10.1037//1089-2680.5.4.323.

Biotti, F., Gray, K. L. H., & Cook, R. Impaired body perception in developmental prosopagnosia. Cortex, 2017,93: 41-4 9. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/316994251. DOI:10.1016/j.cortex. 2017.05.006.

Boone, R. T., & Cunningham, J. G. Children's expression of emotional meaning in music through expressive body mov ement. Journal of Nonverbal Behavior, 2001, 25(1): 21-41. Retrieved on March 18, 2021, from https://www.resear chgate.net/publication/227197360. DOI:10.1023/A:1006733123708.

Boyatzis, C. J., & Satyaprasad, C. Children's facial and gestural decoding and encoding: Relationships between skills and with popularity. Journal of Nonverbal Behavior, 1994, 18(1): 37-55. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/226053138. DOI:10.1007/BF02169078.

Civile, C., & Obhi, S. S. Power eliminates the influence of body posture on facial emotion recognition. Journal of Nonv erbal Behavior, 2016, 40(4): 283-299. Retrieved on March 18, 2021, from https://www.researchgate.net/publicatio n/301343554. DOI:10.1007/s10919-016-0233-0.

de Gelder, B., & Van den Stock, J. The bodily expressive action stimulus test (BEAST). Construction and validation of a stimulus basis for measuring perception of whole body expression of emotions. Frontiers in Psychologyr, 2011,

2: 181. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/51614292. DOI:10.3389/fpsyg.2011.00181.

Ding, X. B., Kang, T. J., Zhao, X., & Fu, J. J.. A comparison for machine processing of emotional body language and fa cial expression. Advances in Psychological Science (in Chinese), 2018, 26(3): 423-432. Retrieved on March 18, 2 021, from http://journal.psych.ac.cn/xlkxjz/EN/10.3724/SP.J.1042.2018.00423.. DOI:10.3724/sp.J.1042.2018.004 23.

Dittrich, W. H., Troscianko, T., Lea, S. E. G., & Morgan, D. Perception of emotion from dynamic point-light displays represented in dance. Perception, 1996, 25(6): 727-738. Retrieved on March 18, 2021, from https://sci-hub.se/10.1068/p250727. DOI:10.1068/p250727.

Elfenbein, H. A., & Ambady, N. On the universality and cultural specificity of emotion recognition: A meta-analysis. Ps ychological Bulletin, 2002, 128(2): 203-235. Retrieved on March 18, 2021, from https://www.researchgate.net/pub lication/11433169. DOI:10.1037/0033-2909.128.2.203.

Elfenbein, H. A., & Ambady, N. Cultural similarity's consequences: A distance perspective on cross-cultural differences in emotion recognition. Journal of Cross-Cultural Psychology, 2003a, 34(1): 92-110. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/247723673. DOI:10.1177/0022022102239157.

Elfenbein, H. A., & Ambady, N. When familiarity breeds accuracy: Cultural exposure and facial emotion recognition. Journal of Personality and Social Psychology, 2003b, 85(2): 276-290. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/10614539. DOI:10.1037/0022-3514.85.2.276.

Engelmann, J. B., & Pogosyan, M. Emotion perception across cultures: The role of cognitive mechanisms. Frontiers in Psychology, 2013, 4: 118. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/236043019. DOI:10.3389/fpsyg.2013.00118.

Frijda, N. H. The Emotions. MA: MIT Press, 1986.

Frijda, N. H. The laws of emotion. American Psychologist, 1988, 43(5): 349-358. Retrieved on March 18, 2021, from https://sci-hub.se/10.1037/0003-066X.43.5.349. DOI:10.1037/0003-066X.43.5.349.

Gross, M. M., Crane, E. A., & Fredrickson, B. L. Methodology for assessing bodily expression of emotion. Journal of Nonverbal Behavior, 2010, 34(4): 223-248. Retrieved on March 18, 2021, from https://www.researchgate.net/publi cation/225733496. DOI:10.1007/s10919-010-0094-x.

Hadjikhani, N., & de Gelder, B. Seeing fearful body expressions activates the fusiform cortex and amygdala. Current B iology, 2003, 13(24): 2201-2205. Retrieved on March 18, 2021, from https://sci-hub.se/10.1016/j.cub.2003.11.049. DOI:10.1016/j.cub.2003.11.049.

Hajduk, M., Klein, H. S., Bass, E. L., Springfield, C. R., & Pinkham, A. E. Implicit and explicit processing of bodily emotions in schizophrenia. Cognitive Neuropsychiatry, 2019, 25(2): 139-153. Retrieved on March 18, 2021, from https://sci-hub.se/10.1080/13546805.2019.1706465. DOI:10.1080/13546805.2019.1706465.

Hansen, C. H., & Hansen, R. D. Finding the face in the crowd: An anger superiority effect. Journal of Personality and Social Psychology, 1988, 54(6): 917-924. Retrieved on March 18, 2021, from https://sci-hub.se/10.1037/0022-3514.54.6.917. DOI:10.1037/0022-3514.54.6.917.

Heck, A., Chroust, A., White, H., Jubran, R., & Bhatt, R. S. Development of body emotion perception in infancy: From discrimination to recognition. Infant Behavior & Development, 2018, 50: 42-51. Retrieved on March 18, 2021, from https://sci-hub.se/10.1016/j.infbeh.2017.10.007. DOI:10.1016/j.infbeh.2017.10.007.

Izard, C. E. The face of emotions. New York, NY: Appleton-Century Crofts Press, 1971.

Jack, R. E., Garrod, O. G. B., Yu, H., Caldara, R., & Schyns, P. G. Facial expressions of emotion are not culturally universal. Proceedings of the National Academy of Sciences, 2012, 109(19): 7241-7244. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/224052915. DOI:10.1073/pnas.1200155109.

Jackson, P. L., Meltzoff, A. N., & Decety, J. How do we perceive the pain of others? A window into the neural processe s involved in empathy. NeuroImage, 2005, 24(3): 771-779. Retrieved on March 18, 2021, from https://www.resear chgate.net/publication/8079707. DOI:10.1016/j.neuroimage.2004.09.006.

Jones, W., & Klin, A. Attention to eyes is present but in decline in 2-6-month-old infants later diagnosed with autism. N ature, 2013, 504(7480): 427-431. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/25 8335466. DOI:10.1038/nature12715.

Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H. J., Hawk, S. T., & van Knippenberg, A. Presentation and validation of the radboud faces database. Cognition and Emotion, 2010, 24: 1377-1388. Retrieved on March 18, 2021, from https://sci-hub.se/10.1080/02699930903485076. DOI:10.1080/02699930903485076.

Limbrecht-Ecklundt, K., Hoffmann, H., Walter, S., Gruss, S., Hrabal, D., Traue, H.C. Pictures of facial affect-ulm (PFA-U): A new facs-based set of pictures for basic emotions. 2013, 153-168. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/278302606. DOI:10.1108/S1746-9791(2013)0000009011.

Malatesta-Magai, C. Z., & Haviland, M. Learning display rules: The socialization of emotion expression in fancy. Child Development, 1992, 53(4): 991-1003. Retrieved on March 18, 2021, from https://pubmed.ncbi.nlm.nih.gov/71282 64/. DOI:10.1111/j.1467-8624.1982.tb01363.x.

Markus, H. R., & Kitayama, S. Culture and the self: Implications for cognition, emotion, and motivation. Psychological Review, 1991, 98: 224-253. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/232558 390. DOI:10.1037/0033-295X.98.2.224.

Mclntosh, D. N., Reichman-Decker, A., Winkielamn, P., & Wilbarger, J. L. When the social mirror breaks: Deficits in automatic, but not voluntary, mimicry of emotional facial expressions in autism. Developmental Science, 2006, 9: 295-302. Retrieved on March 18, 2021, from https://sci-hub.se/10.1111/j.1467-7687.2006.00492.x. DOI:10.1111/j.1467-7687.2006.00492.x.

Mondloch, C. J., Nelson, N. L., & Horner, M. Asymmetries of influence: Differential effects of body postures on perceptions of emotional facial expressions. PLoS ONE, 2013, 8(9): e73605. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/256614270. DOI:10.1371/journal.pone.0073605.

Nelson, N. L., & Mondloch, C. J. Adults' and children's perception of facial expressions is influenced by body postures even for dynamic stimuli. Visual Cognition, 2017, 1-12. Retrieved on March 18, 2021, from https://sci-hub.se/10.1080/13506285.2017.1301615. DOI:10.1080/13506285.2017.1301615.

Nelson, N. L., & Mondloch, C. J. Children's visual attention to emotional expressions varies with stimulus movement. Journal of Experimental Child Psychology, 2018, 172: 13-24. Retrieved on March 18, 2021, from https://sci-hub.se/10.1016/j.jecp.2018.03.001. DOI:10.1016/j.jecp.2018.03.001.

Nyström, P., Bölte, S., & Falck-Ytter, T. Responding to other people's direct gaze-alterations in gaze behavior in infants at risk for autism occur on very short timescales. Journal of Autism and Developmental Disorders,2017, 47(11): 498-3509. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/319471559. DOI:https://doi.org/10.1007/s10803-017-3253-7.

Oleszkiewicz, A., Frackowiak, T., Sorokowska, A., & Sorokowski, P. Children can accurately recognize facial emotions from emoticons. Computers in Human Behavior, 2017, 76: 372-377. Retrieved on March 18, 2021, from https://sci-hub.se/10.1016/j.chb.2017.07.040. DOI:10.1016/j.chb.2017.07.040.

Parker, J. G., & Gottman, J. M. Social and emotional development in a relational context: Friendship interaction from e arly childhood to adolescence. In T. J. Berndt, & G. W. Ladd (Eds.), Peer relationships in child development,.1989: 95-131. John Wiley and Sons. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/232444421.

Righart, R., & de Gelder, B. Impaired face and body perception in developmental prosopagnosia. Proceedings of the National Academy of Sciences, 2007, 104(43): 17234-17238. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/5902313. DOI:10.1073/pnas.0707753104.

Ross, P., & Flack, T. Removing hand form information specifically impairs emotion recognition for fearful and angry body stimuli. Perception, 2019, 49(1): 98-112. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/337767593. DOI:10.1177/0301006619893229.

Sauter, D. A., McDonald, N. M., Gangi, D. N., & Messinger, D. S. Nonverbal expressions of positive emotions. In M. N. Tugade, M. N. Shiota, & L. D. Kirby (Eds.), Handbook of positive emotions, 2014:179-200. New York: Guilford Press. Retrieved onMarch 18, 2021, from https://www.researchgate.net/publication/315757999.

Shic, F., Macari, S., & Chawarska, K. Speech disturbs face scanning in 6-month-old infants who develop autism spectrum disorder. Biological Psychiatry, 2014, 75(3): 231-237. Retrieved on March 18, 2021, from https://sci-hub.se/10.1016/j.biopsych.2013.07.009. DOI:10.1016/j.biopsych.2013.07.009.

Susilo, T., Yovel, G., Barton, J. J., & Duchaine, B. Face perception is category-specific: Evidence from normal body perception in acquired prosopagnosia. Cognition, 2013, 129(1): 88-94. Retrieved on March 18, 2021, from https://sci-hub.se/10.1016/j.cognition.2013.06.004. DOI:10.1016/j.cognition.2013.06.004.

Thoma, P., Soria Bauser, D., & Suchan, B. BESST (Bochum Emotional Stimulus Set)-A pilot validation study of a stimulus set containing emotional bodies and faces from frontal and averted views. Psychiatry Research, 2013, 209(1): 98-109. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/233877213. DOI:10.1016/j.psychres.2012.11.012.

van de Riet, W. A., Grezes, J., & de Gelder, B. Specific and common brain regions involved in the perception of faces and bodies and the representation of their emotional expressions. Social Neuroscience, 2009, 4(2): 101-120. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/24172264. DOI:10.1080/17470910701865367.

Van den Stock, J., & de Gelder, B. Face identity matching is influenced by emotions conveyed by face and body. Frontiers in Human Neurosciencer, 2014, 8(1): 53. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/260397110. DOI:https://doi.org/10.3389/fnhum.2014.00053.

Van den Stock, J., Righart, R., & de Gelder, B. Body expressions influence recognition of emotions in the face and voice. Emotion, 2007, 7(3): 487-494. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/6156738. DOI:https://doi.org/10.1037/1528-3542.7.3.487.

Watson, R., & de Gelder, B. The representation and plasticity of body emotion expression. Psychological Research, 2020, 85(4): 1400-1406. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/330091390. DOI:10.1007/s00426-018-1133-1.

Widen, S. C., & Russell, J. A. Children acquire emotion categories gradually. Cognitive Development, 2008, 23(2): 291-312. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/222565427. DOI:10.1016/j.cogdev.2008.01.002.

Yamashiro, S., Sorcinelli, A., Rahman, T., Elbogen, R., Curtin, S., & Vouloumanos, A. Shifting preferences for primate faces in neurotypical infants and infants later diagnosed with ASD. Autism Research, 2018, 1-14. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/329762614.DOI:10.1002/aur.2043.

Young, A.W., Perrett, D., Calder, A., Sprengelmeyer, R., & Ekman, P. Facial expressions of emotion: Stimuli and tests (FEEST). Thames Valley Test Company, Bury St. Edmunds, 2022,10:1-4. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/252068424.

Zhang, D. D., Zhao, T., Liu, Y. Z., & Chen, Y. M. Comparison of facial expressions and body expressions: An event-related potential study. Acta Psychologica Sinica (in Chinese), 2015, 47(8): 963-970. Retrieved on March 18, 2021, from https://www.researchgate.net/publication/312370459. DOI:10-3724/SP.J.104.2015.00963.

Figure Legends

Fig. 1 Examples of stimuli for female and male actors. From left to right: happiness, sadness, fear and anger

Fig. 2 Heat map of body gesture recognition in adults (A-happiness recognition, B-sadness recognition, C-fear recognition, D-anger recognition, the same below)

Fig. 3 Heat map of body gesture recognition in children

Figure 4. Proportion correct recognitions of four body expressions in adults.

(*$p < .05$, **$p < .01$, ***$p < .001$, the same below)

Figure 5. Proportion correct recognitions of four body expressions in children

Figure 6. Proportion correct recognitions of four body expressions in adults and children

Figures

Fig. 1 Examples of stimuli for female and male actors. From left to right: happiness, sadness, fear and anger

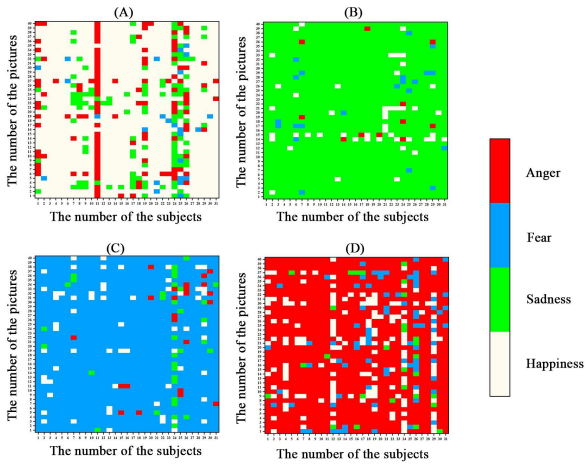

Fig. 2 Heat map of body gesture recognition in adults

(A-happiness recognition, B-sadness recognition, C-fear recognition, D-anger recognition, the same below)

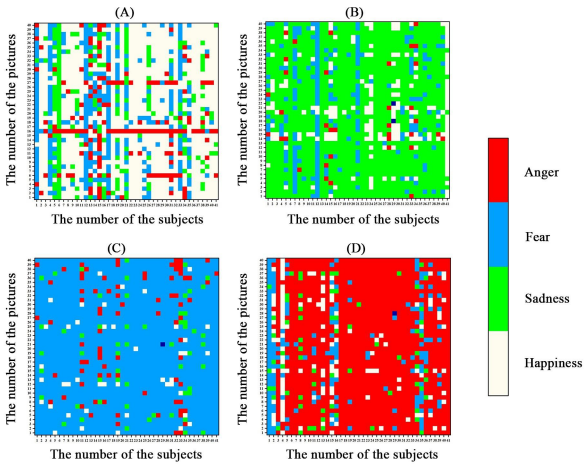

Fig. 3 Heat map of body gesture recognition in children

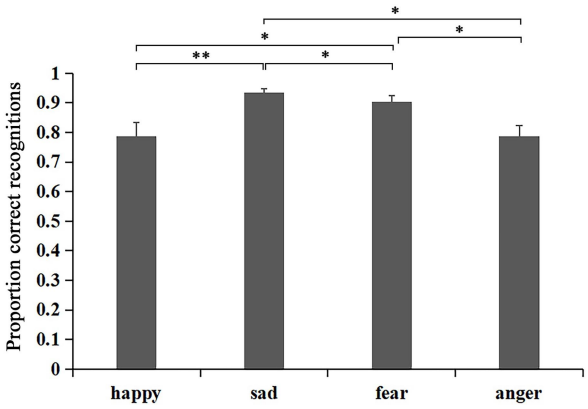

Figure 4. Proportion correct recognitions of four body expressions in adults.

(*p < .05, **p < .01, ***p < .001, the same below)

Figure 5. Proportion correct recognitions of four body expressions in children

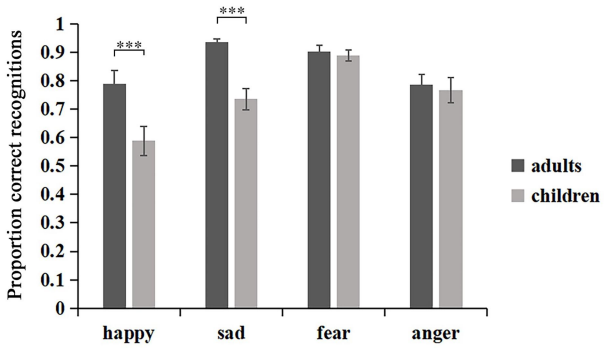

Figure 6. Proportion correct recognitions of four body expressions in adults and children